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MORPHOLOGICAL DIFFERENCES IN GENITALIA OF *BRUCHOPHAGUS* (HYMENOPTERA: CHALCIDAE) THAT INFEST ALFALFA, RED CLOVER, AND BIRDSFOOT TREFOIL SEEDS (HYMENOPTERA: EURYTOMIDAE)

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Abstract.—Morphology of female and male genitalia of *Bruchophagus gibbus* (Boheman), *B. roddi* Gussaskovskii, and *B. platypterus* (Walker) was studied in specimens collected in Arizona, California, Maryland, South Dakota, and Wisconsin from red clover (*Trifolium pratense* L.), alfalfa (*Medicago sativa* L.), and birdsfoot trefoil (*Lotus corniculatus* L.), respectively.

Key Words: *Bruchophagus,* alfalfa, red clover, birdsfoot trefoil, genitalia

The name *Bruchophagus funebris* Howard was applied by Urbahns (1920) and Sorenson (1930) to eurytomids reared from alfalfa (*Medicago sativa* L.) and red clover (*Trifolium pratense* L.) seeds in the United States during the early 1900s. After 1930 and until 1952, as pointed out by Strong (1962), the name *Bruchophagus gibbus* (Boheman) was indiscriminately applied to eurytomids reared from seeds of legumes in North America. However, as early as 1933 Russian entomologists reported a new species, *Bruchophagus roddi* Gussakovskii, from alfalfa seeds (Strong 1962). Fedoseeva (1956) described *Bruchophagus kolobovae* Fedoseeva from seeds of birdsfoot trefoil (*Lotus corniculatus* L.) in Russia, and Neunzig and Gyrisco (1958) concluded that eurytomids reared from birdsfoot trefoil seeds in North America were *B. kolobovae.* Strong (1962) studied male and female genitalia of eurytomids reared from alfalfa, red clover, and birdsfoot trefoil seeds and concluded that three distinct species, *B. roddi, B. gibbus,* and *B. kolobovae,* respectively, infested these legumes in North America. He used the relative angle formed by the second rami and the second valvifer to separate the three species. Graham (1970) examined lectotypes of eurytomids from red clover and birdsfoot trefoil and concurred with Fedoseeva's (1956) and Strong's (1962) conclusion that species from red clover and birdsfoot trefoil were not conspecific. Graham (1970) compared lectotype females of *Systole platyptera* Walker with reared material of *B. kolobovae* and considered them to be conspecific. Strong (1962) reported the male genitalia of the three species were almost morphologically identical, and Graham (1970) found less evident differences between males than females of *B. gibbus, B. roddi,* and *B. platypterus.*

The objectives of this research were to describe the morphology of the female and male genitalia of *B. gibbus, B. roddi,* and *B. platypterus* collected in the United States and to identify quantitative genitalia characteristics, in addition to those described by Strong (1962), that have taxonomic significance.

Materials and Methods

Genitalia from 30 females and 20 males of *B. gibbus, B. roddi,* and *B. platypterus* were mounted on slides in Hoyer's solution and observed at 100–1200 magnifications. Data obtained for females were ovipositor sheath length, number of ovipositor sheath setae, number of right and left ramus spines, and number of eighth tergite setae. The length of the reproductive apparatus was determined for males.

Origins of the specimens studied were as follows. For *B. gibbus,* 25 females and 10 males were from three different counties in South Dakota, and five females and 10 males were from Woodsboro, Maryland (Frederick Co.). For *B. roddi,* 23 females and 11 males were from 10 different counties in South Dakota, 5 females and one male were from Fresno, California (Fresno Co.), 2 females were from Chandler, Arizona (Maricopa Co.) and eight males were from Madison, Wisconsin (Dane Co.). For *B. platypterus,* 17 females and 11 males were from Brookings, South Dakota (Brookings Co.), and 13 females and 9 males were from Madison, Wisconsin (Dane Co.).

Quantitative data were subjected to analysis of variance and means were compared by the least significant difference at the 0.01 level.

Results and Discussion

Description of Genitalia Morphology

Bruchophagus gibbus

Female (Fig. 1): Second valvifers (Vf2) with two setae near apodemes of laminated bridge (Lam.Br.); rami spines (Ra.Sp.) range from 30 to 36 on right valvifers (mean of 33.0 for 30 specimens) and from 24 to 36 on left valvifers (mean of 32.3 for 30 specimens), spines widely spaced in laminated bridge region, close together near fulcral plate region; fulcral plate (Ful.Pl.) attachment of ovipositor outer plate (Ops.Ot.Pl.) near fulcral plate notch (Ful.Pl.Not.); fulcral plate with deep notch, head region with

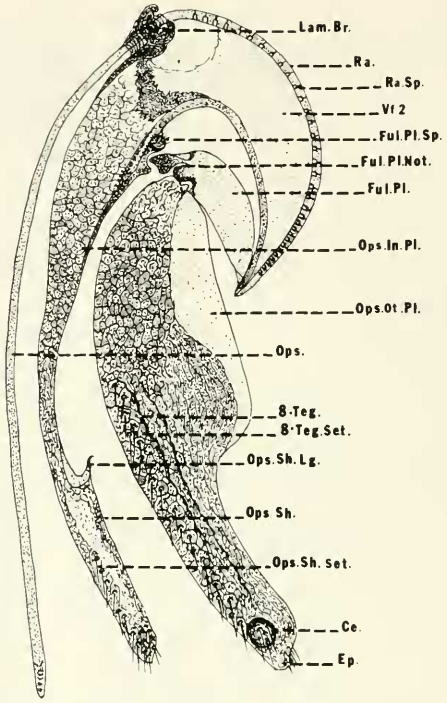
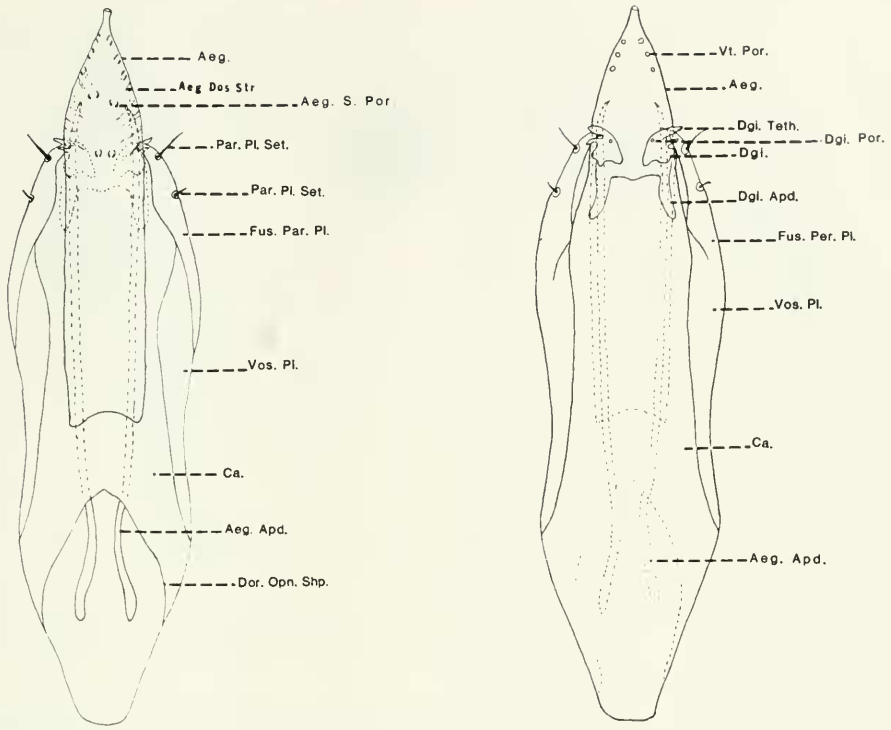


Fig. 1. Female genitalia of *Bruchophagus gibbus* (Boheman).

pointed apex; outer ovipositor plate fused with eighth tergite (8th.Teg.), sclerotized, plate in area near attachment of fulcral plate, ventral area membranous; eighth tergite with single row of setae, number of setae ranging from 31 to 49 (mean of 38.6 for 30 specimens); setal region plated similar to dorsal fused area of outer ovipositor plate; eighth tergite separated from ventral region of outer ovipositor plate by two dark striae that extend from fused dorsal area of outer ovipositor plate to cercus (Ce.); eighth tergite with a series of long setae beyond cercus, similar in structure to other eighth tergite setae located on epipygium (Ep.); cercus with five setae of different sizes and shapes; ovipositor inner plate (Ops.In.Pl.) separated from second valvifers by darkened region that connects apodemes of outer and inner rami and apodemes of laminated bridge; this darkened area separates plated region on inner ovipositor plate from membranous



Figs. 2, 3. Male reproductive apparatus of *Bruchophagus gibbus* (Boheman) dorsal and ventral respectively.

centers of second valvifers; second valvifer rami fused with fulcral plate extending past darkened region forming a groove in which fulcral plate apex fits; above this groove are four monitoring spines (Ful.Pl.Sp.); this region fused to rami apodemes forming shaft for ovipositor (Ops.); inner ovipositor plate with plated region extending to region of fused ovipositor sheath (Ops.Sh.); ovipositor sheaths not articulated, connected to each other by ovipositor ligament (Ops.Sh.Lg.); ovipositor sheath length (Fig. 4) 285 to 420 microns for 30 specimens; ovipositor sheaths lightly striated; ovipositor sheath setae (Ops.Sh.Set.) grouped together at apex with from 8 to 16 setae extending from apex setae toward ovipositor sheath ligament area; ovipositor (Ops.) with typical *Bruchophagus* teeth on the shaft with a single median tooth followed by paired lateral teeth.

Male (Figs. 2, 3): Reproductive apparatus with four dorsal aedeagal sensory pores (Aeg.S.Por.), these paired or staggered, two pairs located within aedeagal striae, aedeagal dorsal striae (Aeg.Dos.Str.) reaching second aedeagal sensory pores; ventral apex of aedeagus with three sensory pores on each side, these smaller than dorsal sensory pores; aedeagus (Aeg.) elongated; aedeagal apparatus length measured (Fig. 4d) from digital apodemes (Dgi.Apd.) 360 to 440 microns (mean of 382 microns for 20 specimens); aedeagus capable of extending beyond digiti; attached to dorsal surface is aedeagal epipygium ligament (Aeg.Ep.Lg.) (Fig. 4a, b), that extends to epipygium (eighth tergite); parameres with three setae; apex setae normally hidden between digiti and aedeagus; paramere plate setae (Par.Pl.Set.) located on outer margin of curved paramere plate; paramere plate setae next to apex seta longer and larger than other paramere plate setae; paramere plate setae located near fused paramere and volsellar plate (Vos.Pl.) similar in size to apex paramere setae; digiti (Dgi.)

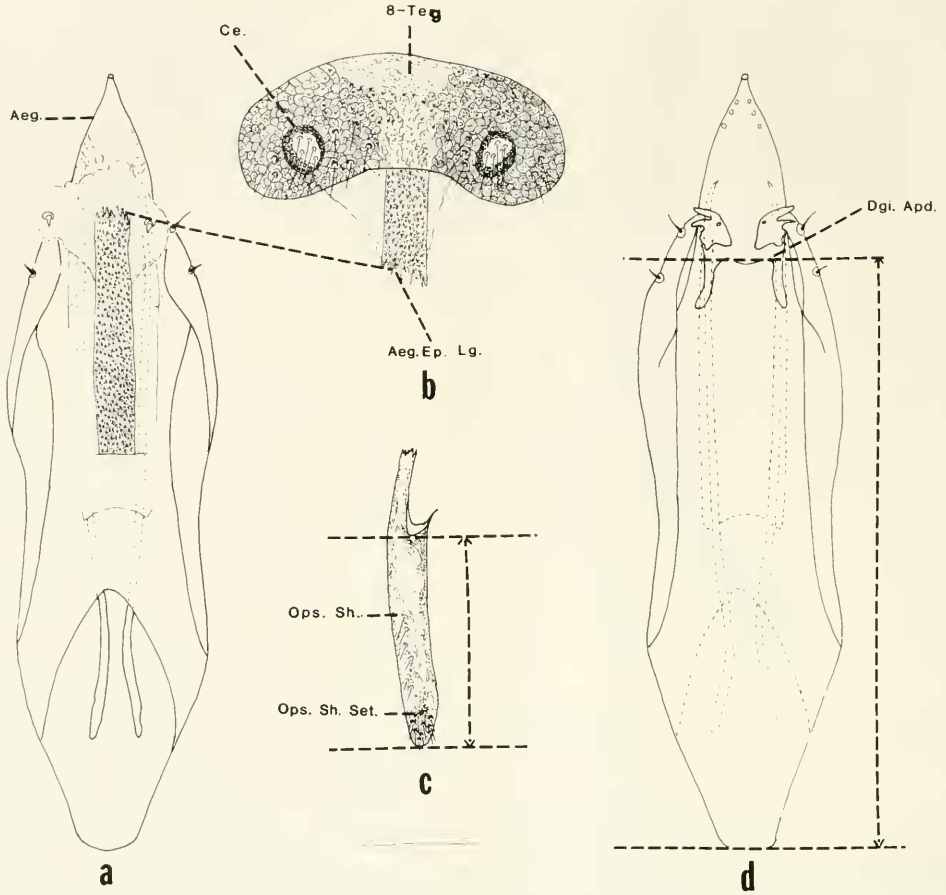


Fig. 4. a—Male reproductive apparatus with aedeagus epipygium ligament attached to aedeagus associated with membranous sheath bearing two acorn-like setae. b—Male eighth tergite with attachment of aedeagus epipygium ligament and membranous sheath. c—Ovipositor sheath showing how length is measured. d—Male reproductive apparatus showing how length is measured.

Abbreviations: (Aeg.Ep.Lg.) Aedeagus epipygium ligament; (Aeg.) Aedeagus; (Ce.) Cercus; (8th.Teg.) Eighth tergite; (Ops.Sh.) Ovipositor sheath; (Ops.Sh.Set.) Ovipositor sheath setae; (Dgi.Apd.) Digiti apodemes.

with two finger-like teeth and a rounded projection on outer margin of molar, each molar with a single pore on base; digital apodemes (Dgi.Apd.) fused to aedeagal apodemes; (Aeg.Apd.); aedeagal apodemes protrude from caulis (Ca.) dorsally; caulis, paramere plate and volsellar plate (Vos.Pl.) fused, pigmentation darker on paramere plate section that contains paramere plate setae; center region of caulis transparent allowing observation of aedeagal apodemes; caulis forms opening on dorsal surface where aedeagal apodemes protrude.

Bruchophagus roddi

Female (Fig. 5): Second valvifers (Vf2) with two setae near apodemes of laminated bridge (Lam.Br.); rami spines (Ra.Sp.) range from 24 to 41 on right valvifer (mean of 28.6 for 30 specimens) and from 25 to 39 on left valvifer (mean of 28.5 for 30 specimens); spines widely spaced in laminated bridge region, close together near fulcral plate (Ful.Pl.) region; fulcral plate attachment of ovipositor outer plate (Ops.Ot.Pl.) located near notch of fulcral plate; fulcral

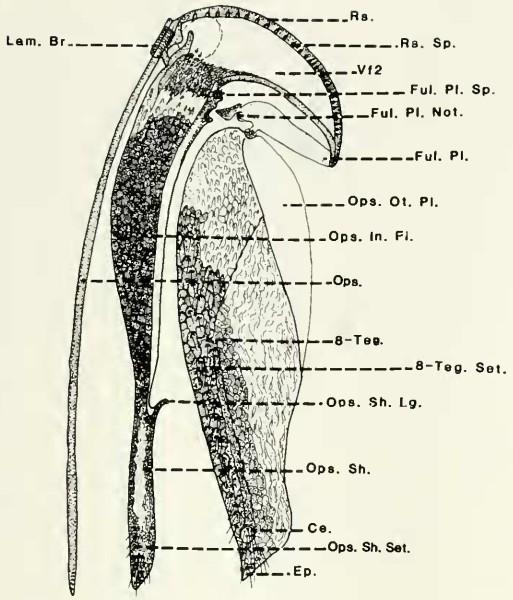
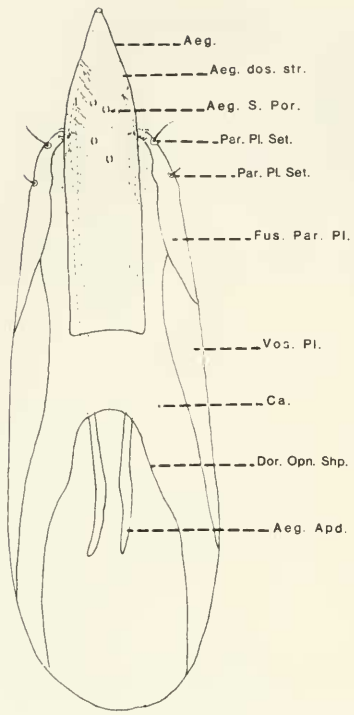
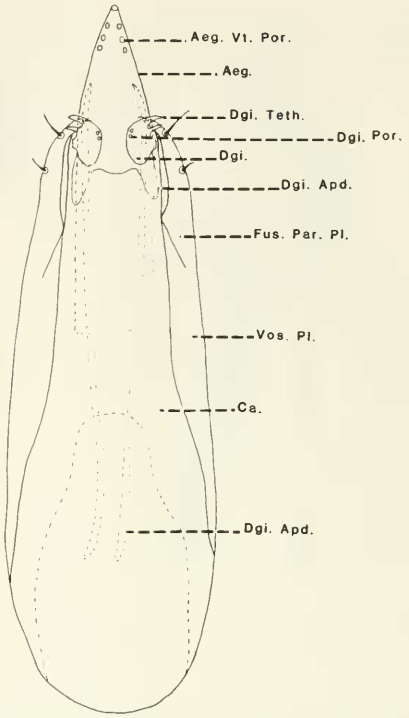


Fig. 5. Female genitalia of *Bruchophagus roddi* Gussakovskii.

plate notch (Ful.Pl.Not.) deep; fulcral plate apex pointed, fulcral plate margin bordering rami of lower second valvifer with pronounced rounded hump; apex of fulcral plate fits into notched ovipositor inner plate (Ops.In.Pl.); ovipositor outer plate fused with eighth tergite (8th.Teg.) lightly sclerotized with plating concentrated on and around eighth tergite region that contains eighth tergite setae (8th.Teg.Set.); dorsal area of ovipositor outer plate membranous; eighth tergite with double row of setae, number of setae range from 44 to 64 (mean of 54.0 for 30 specimens); setal region plated similar to ventral area of outer ovipositor plate, plating absent on area near attachment of outer ovipositor plate and fulcral plate; eighth tergite separated from dorsal region of outer ovipositor plate by two dark striae that extend from fused ventral area of ovipositor outer plate to cercus (Ce.); eighth tergite with a series of long setae beyond cercus, similar in structure to other eighth tergite setae, these associated with epipygium (Ep.); cercus with five setae of different lengths and sizes; ovipositor inner plate (Ops.In.Pl.) separated from second valvifers by darkened region that connects apodemes of upper and lower rami of second valvifers and apodemes of laminated bridge; this darkened area separates plated region of ovipositor inner plate from membranous centers of second valvifers; lower second valvifer ramus which articulates with fulcral plate extends beyond darkened region and forms groove in which fulcral plate apex fits; above groove are four monitoring spines (Ful.Pl.Sp.); region fused forming shaft for ovipositor (Ops.); ovipositor inner plate with plated region extending to fused ovipositor sheath (Ops.Sh.); ovipositor sheaths not articulated, connected by ovipositor sheath ligament (Ops.Sh.Lg.); ovipositor sheath length (Fig. 4c) 250 to 330 microns (mean 276 microns for 30 specimens); ovipositor sheath lightly striated; ovipositor sheath setae (Ops.Sh.Set.) grouped together at apex with from 6 to 16 setae extending from grouped apex setae toward ovipositor sheath ligament area; ovipositor (Ops.) with typical *Bruchophagus* teeth on shaft, with single median tooth followed by paired lateral teeth.

Male (Figs. 6, 7): Reproductive apparatus with four aedeagal sensory pores (Aeg. S.Por.), these paired or staggered, one pair located within striae region of aedeagus, striae not reaching to second pair of sensory pores; paired sensory pores may be close to each other or spaced far apart (in *B. roddi* the staggered position is the normal pattern); aedeagal dorsal striae (Aeg.Dos.Str.) of different lengths; ventral apex of aedeagus with three sensory pores on each side, these smaller in size than dorsal sensory pores; aedeagus (Aeg.) elongated length measured (Fig. 4d) from digital apodemes (Dgi.Apd.) 240 to 315 microns (mean of 283 microns for 20 specimens); aedeagus capable of extending beyond aedeagal digiti (Dgi.); attached to dorsal surface is the aedeagal epipygium ligament (Aeg.Ep.Lg.); parameres with three setae; apex setae hidden between digiti and aedeagus; paramere plate setae





Figs. 6, 7. Male reproductive apparatus of *Bruchophagus roddi* Gussakovskii, dorsal and ventral respectively.

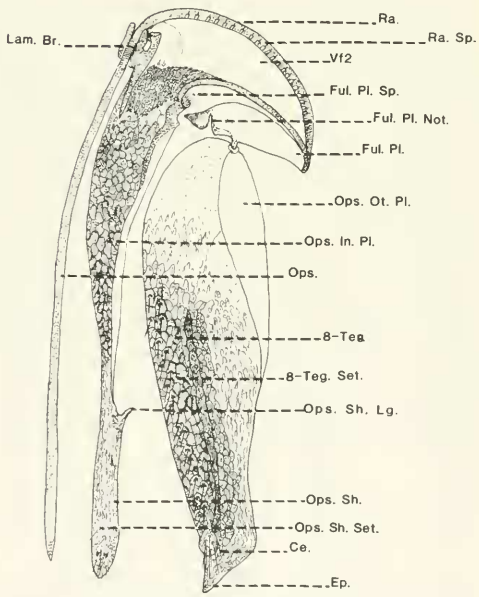


Fig. 8. Female genitalia of *Bruchophagus platypterus* Walker.

(Par.Pl.Set.) located on outer margin of curved paramere plate (Par.Pl.); paramere setae next to apex seta longer and larger than other paramere setae; paramere setae located near fused paramere and volsellar plate (Vos.Pl.) similar in size to apex paramere setae; digiti (Dgi.) with two finger-like teeth and a rounded projection on outer margin of molar, molar region with single pore; digital apodemes (Dgi.Apd.) fused to volsellar plate; aedeagal apodemes (Aeg.Apd.) protrude from caulis (Ca.) dorsally; caulis, paramere plate and volsellar plate fused; paramere plate region that contains paramere setae pigmented; caulis center region transparent; caulis forms dorsal opening where aedeagal apodemes protrude.

Bruchophagus playpterus

Female (Fig. 8): Second valvifers (Vf2) with two setae near apodemes of laminated bridge (Lam.Br.); rami spines (Ra.Sp.) range

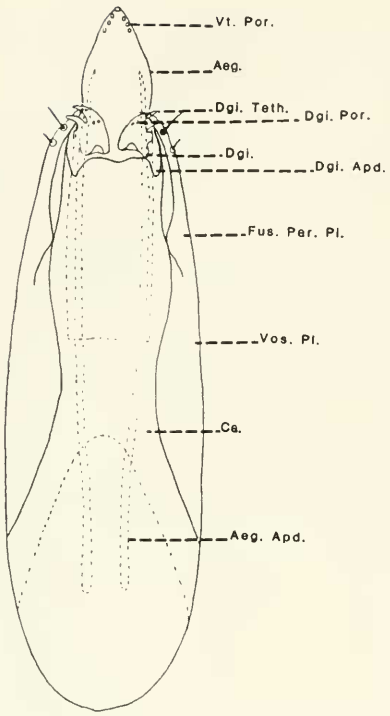
from 18 to 29 on right valvifer (mean of 24.6 for 30 specimens), and from 19 to 28 on left valvifer (mean of 24.3 for 30 specimens); spines widely spaced in laminated bridge region, close together near fulcral plate (Ful.Pl.) region; fulcral plate attachment of ovipositor outer plate (Ops.Ot.Pl.) located near apex of fulcral plate; fulcral plate notch (Ful.Pl.Not.) deep; fulcral plate apex pointed; fulcral plate margin bordering rami of lower second valvifer without pronounced rounded hump; apex of fulcral plate fits into notched ovipositor inner plate (Ops.In.Pl.); ovipositor outer plate fused with eighth tergite (8th.Teg.) sclerotized with plating extending to attachment of outer ovipositor plate and second valvifer (plating may be absent or lightly marked); dorsal area of ovipositor outer plate membranous; eighth tergite with double row of setae; number of setae range from 37 to 67 (mean of 51.2 for 30 specimens); setal region of eighth tergite plated; eighth tergite with a series of long setae beyond cercus, similar in structure to other eighth tergite setae, these associated with epipygium (Ep.); cercus with five setae of different lengths and sizes; ovipositor inner plate (Ops.In.Pl.) separated from second valvifers by darkened region that separates plated region of ovipositor inner plate from membranous center of second valvifers; lower second valvifer ramus which articulates with fulcral plate extends beyond darkened region forming a groove in which fulcral plate apex fits; above groove are four monitoring spines (Ful.Pl.Sp.); this region fused forming shaft for ovipositor (Ops.); ovipositor inner plates plated region extends to fused ovipositor sheath (Ops.Sh.); ovipositor sheath not articulated, connected by ovipositor sheath ligament (Ops.Sh.Lg.); ovipositor sheath length (Fig. 4c) 185 to 220 microns (mean of 208 microns for 30 specimens); ovipositor sheath lightly striated; ovipositor sheath setae (Ops.Sh.Set.) grouped together at apex with from 4 to 12 setae extending from grouped apex setae toward ovipositor sheath ligament area; ovipositor (Ops.) with typical *Bruchophagus* teeth on shaft, with single median tooth followed by paired lateral teeth.

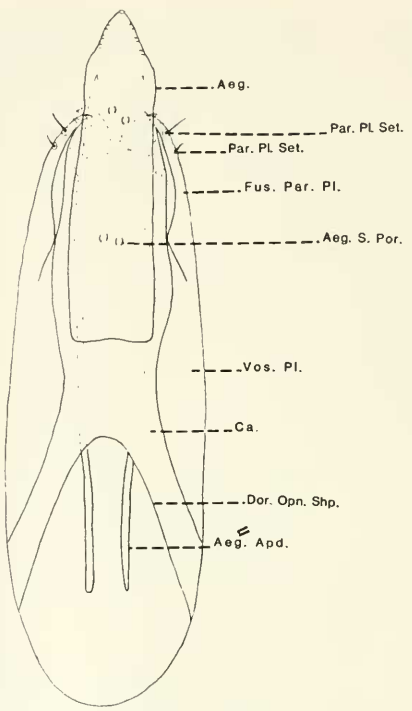
Male (Figs. 9, 10): Reproductive apparatus with four aedeagal sensory pores (Aeg.S.Por.), these paired or staggered, paired pores may be close to each other or spaced far apart; normal spacing is far apart; aedeagal striae absent; aedeagal ventral apex with three pairs of sensory pores on each side, these smaller in size than aedeagal dorsal sensory pores; aedeagus (Aeg.) elongated, length measured (Fig. 4d) from digital apodemes (Dgi.Apd.) 260 to 300 microns (mean of 279 microns for 20 specimens); aedeagus capable of extending beyond aedeagal digiti (Dgi.); aedeagal epipygium ligament present; parameres with three setae; apex setae hidden between digiti and aedeagus; paramere plate setae (Par.Pl.Set.) located on outer margin of curved paramere plate; paramere setae next to apex setae longer and larger than other paramere setae; paramere setae located near fused paramere and volsellar plate (Vos.Pl.); similar in size to apex paramere setae; digiti (Dgi.) with two finger-like teeth and a rounded projection on outer margin of molar, molar without pores; digital apodemes (Dgi.Apd.) fused to volsellar plate; aedeagal apodemes (Aeg.Apd.) protrude from caulis (Ca.) dorsally; caulis, paramere plate and volsellar plate fused; paramere plate region containing paramere setae pigmented; caulis forms dorsal opening where aedeagal apodemes protrude.

Key to Females and Males of *Bruchophagus gibbus*, *B. roddi* and *B. playpterus* Using Reproductive Structures

Females

1. Ovipositor sheath length greater than 310 microns (Fig. 4c); eighth tergite with a single row of setae (Fig. 1) ..... *B. gibbus*
   Ovipositor sheath length less than 310 microns; eighth tergite with paired setae forming a double row (Figs. 5, 8) 2





Figs. 9, 10. Male reproductive apparatus of *Bruchophagus platypterus* Walker, dorsal and ventral respectively.

Abbreviations used for female genitalia of all three species; (Lam.Br.) Laminated bridge; (Ra.) Ramus; (Ra.Sp.) Ramus spines; (Vf2) 2nd Valvifer; (Ful.Pl.Sp.) Fulcral plate spines; (Ful.Pl.Not.) Fulcral plate notch; (Ful.Pl.) Fulcral plate; (Ops.In.Pl.) Ovipositor inner plate; (Ops.Ot.Pl.) Ovipositor outer plate; (Ops.) Ovipositor; (8th.Teg.) 8th tergite; (8th.Teg.Set.) 8th tergite setae; (Ops.Sh.Lg.) Ovipositor sheath ligament; (Ops.Sh.) Ovipositor sheath; (Ops.Sh.Set.) Ovipositor sheath setae; (Ce.) Cercus; (Ep.) Epipygium.

Abbreviations used for male reproductive apparatus of all three species, dorsal and ventral: (Aeg.) Aedeagus; (Aeg.Dos.Str.) Aedeagal dorsal striae; (Aeg.S.Por.) Aedeagal sensory pore; (Par.Pl.Set.) Paramere plate setae; (Fus.Par.Pl.) Fused paramere plate; (Vos.Pl.) Volsellar plate; (Ca.) Caulis; (Aeg.Apd.) Aedeagal apodemes; (Dor.Opn.Shp.) Dorsal opening shape; (Vt.Por.) Ventral pores; (Dgi.) Digiti; (Dgi.Teth) Digiti teeth; (Dgi.Apd.) Digiti apodemes.

2. Ovipositor sheath length between 260 and 290 microns in length ..... *B. roddi*
   Ovipositor sheath length less than 225 microns in length ..... *B. platypterus*

Males

1. Aedeagus with striae associated with one or more pairs of dorsal sensory pores; dorsal sensory pore pairs close together (Figs. 2, 6) 2
   Aedeagus without striae associated with dorsal sensory pores (Figs. 9, 10); length of reproductive apparatus less than 325 microns (see Fig. 4d); dorsal sensory pore pairs separated from each other by more than half the length of aedeagus ..... *B. platypterus*
2. Aedeagus striae encompassing both pairs of dorsal sensory pores (Fig. 2); length of reproductive apparatus greater than 350 microns (see Fig. 4d); dorsal opening shape as shown in Fig. 2 ..... *B. gibbus*
   Aedeagus striae not encompassing both pairs of dorsal sensory pores (Fig. 6); length of reproductive apparatus less than 350 microns (see Fig. 4d); dorsal opening shape as shown in Fig. 6 ..... *B. roddi*

The aedeagus epipygium ligament (Aeg.Ep.Lg.) (Fig. 4b) is here for the first time given a name. This structure was referred to by McDaniel and Boe (1990) as a covering attached to the eighth tergite and reference was made to the small setae that covered the structure. The aedeagus epi-

Table 1. Means and standard deviations of quantitative female genitalia characteristics for *B. gibbus, B. roddi,* and *B. platypterus.*

Species	Ovipositor Sheath Length	Rami Spines	Ovipositor Sheath Setae	Eighth Tergite Setae
	microns	No.	No.	No.
B. gibbus	349 ± 37a[1]	65.3 ± 3.9a	12.6 ± 21a	38.4 ± 5.1a
B. roddi	276 ± 16b	57.1 ± 6.5b	8.9 ± 2.7b	54.0 ± 6.0b
B. platypterus	208 ± 12c	48.9 ± 4.9c	6.8 ± 1.7c	51.2 ± 7.1b

[1] Means in same column followed by different letter are significantly different at the 0.01 level.

pygium ligament is attached to a clear membrane that surrounds the reproductive apparatus. This membranous covering contains two acorn-like setae. Associated with a similar membrane attached to the epipygium of females are two acorn-like setae identical to those found on males. The aedeagus epipygium ligament is beset with spine-like setae and covered with a fatty globular material. This material masks the structure of most of the setae on the ligament. However, the setae located on the section of the aedeagus epipygium ligament attachment of the epipygium can be seen clearly and their structure noted. If this ligament remains attached to the aedeagus when extracting the reproductive apparatus it will occlude the dorsal striae and dorsal sensory pores of the aedeagus. In these cases, length of the reproductive apparatus can be used in separating the males of the three species. The dorsal caulis opening shape can be used to separate the males of all three species. However, it was found that this area of the reproductive apparatus can be damaged in the process of removing the whole male reproductive apparatus from its connection to the eighth tergite. In dried pinned specimens this area is very brittle and the shape of this opening is many times destroyed during the removal of the reproductive apparatus. The dorsal sensory pores have been found to be a valuable species character in separating the three species. These pores are paired, and may be opposite to each other or staggered. The distance of the pairs of sensory pores from each other has been found to be important in separating *B. platypterus* from *B. roddi* and *B. gibbus.*

Table 2. Means and standard deviations of male reproductive apparatus lengths for *B. gibbus, B. roddi,* and *B. platypterus.*

Species	Male Reproductive Apparatus Length
	microns
B. gibbus	382 ± 18a[1]
B. roddi	283 ± 22b
B. platypterus	279 ± 8b

[1] Means followed by different letter are significantly different at 0.01 level.

The female genitalia of all three species tend to be similar for most structures. There is a size difference between the whole reproductive structure of *B. gibbus* and *B. roddi* and *B. platypterus.* If the extracted ovipositor of *B. gibbus* is placed next to the ovipositor of either *B. roddi* or *B. platypterus* the larger size of *B. gibbus* is very evident. Another character that is of value in separating *B. gibbus* from *B. roddi* and *B. platypterus* is the single row of setae on the eighth tergite. *B. roddi* and *B. platypterus* have a double row of setae on the eighth tergite. An occasional single seta may occur but the setae form a definite double row in contrast to the single row found on *B. gibbus.* There may appear to be a difference between the plating on both the outer and inner ovipositor plates; however, it was found that some individuals may have very light plating causing difficulty in using the presence or absence of plating in different regions for separating species. To the trained

eye the shape of the darkened region between the valvifers is diagnostic.

Analysis of Quantitative Characters

Highly significant (P less than 0.01) differences were found among the three species for ovipositor sheath length, number of rami spines, number of ovipositor sheath setae, number of eighth tergite setae, and male reproductive apparatus length (Tables 1, 2). Ovipositor sheath length was significantly longer for *B. gibbus* than *B. roddi* and significantly longer for *B. roddi* than *B. platypterus*. The same relationships between species were observed for numbers of rami spines and ovipositor sheath setae (Table 1). Number of eighth tergite setae was significantly higher for *B. roddi* and *B. platypterus* than *B. gibbus*.

Male reproductive apparatus length was significantly greater for *B. gibbus* than *B. roddi* or *B. platypterus* (Table 2). The apparatus of *B. gibbus* was approximately 35% longer than those of the other two species.

Although significant differences were found among species for the four female and single male genitalia characteristics, the usefulness of any single characteristic for taxonomic purposes is limited by relatively wide ranges of intraspecific variation. For example, the ovipositor sheath length of 23% of the *B. roddi* individuals fell within the range for *B. gibbus*, but no overlap was found for *B. gibbus* and *B. platypterus*. A similar relationship between species was also observed for number of rami spines. Ranges overlapped for *B. roddi* and *B. gibbus* as well as *B. roddi* and *B. platypterus*, but ranges of *B. gibbus* and *B. platypterus* did not. Length of the male reproductive apparatus was useful for separating *B. gibbus* from *B. roddi* and *B. platypterus* since the length of the shortest *B. gibbus* apparatus was approximately 50 microns longer than the longest apparatus for *B. roddi* and *B. platypterus*. Overlaps in the ranges of all three species were observed for numbers of ovipositor sheath and female eighth tergite setae. However, *B. roddi* and *B. platypterus* can be separated from *B. gibbus* by arrangement of eighth tergite setae. *B. roddi* and *B. platypterus* have a double row of eighth tergite setae compared to a single row for *B. gibbus*.

We observed the relative angle formed by the second rami and second valvifers used by Strong (1962) to separate the three species. We concur with his observations but found this angle to be influenced by the amount of pressure applied during slide preparation. Strong (1962) also pointed out that the male genitalia of *B. gibbus* were significantly larger than those of *B. roddi* and *B. platypterus*. However, he examined only 3 specimens of *B. platypterus* and thus was not able to accurately compare the size of the aedeagi of *B. roddi* and *B. platypterus*.

These data indicated large interspecific quantitative differences in male and female genitalia characteristics of *B. gibbus, B. roddi,* and *B. platypterus*. However, they also revealed substantial intraspecific variation that makes species separation based strictly on quantitative genitalia characteristics somewhat difficult. We have described morphological differences among species for arrangement of eighth tergite setae on the females and aedeagal striae on the males that are useful for separating these three species. These traits, when used in combination with the easily measured quantitative traits, provide additional guidelines for researchers who are uncomfortable with Strong's (1962) characters for separation of the three species.

Literature Cited

Fedoseeva, L. I. 1956. New species of the genus *Bruchophagus* Ashm. (Hymenoptera: Chalcidoidea) developing upon leguminous plants. Doklady Akad. Nauk. SSSR 111: 491–493.

Graham, M. W. R. deV. 1970. Taxonomic notes on some Palearctic Eurytomidae (Hymenoptera: Chalcidoidea). Proc. R. Entomol. Soc. Lond. 39: 139–152.

McDaniel, B. and A. Boe. 1990. Life history studies,

host records, and morphological descriptions of genitalia of *Eurytoma tylodermatis* Ashm. (Eurytomidae) from South Dakota. Proc. Entomol. Soc. Wash. 93: 96–100.

Neunzig, H. H. and G. G. Gyrisco. 1958. Host relationships of seed chalcids reared from birdsfoot trefoil. Jour. Econ. Entomol. 51: 409–410.

Sorenson, C. J. 1930. The alfalfa-seed chalcis-fly in Utah. 1926–1929, inclusive. Utah Agric. Exper. Stat. Bull. 218.

Strong, F. E. 1962. Studies on the systematic position of the *Bruchophagus gibbus* complex (Hymenoptera: Eurytomidae). Ann. Entomol. Soc. Amer. 55: 1–4.

Urbahns, T. D. 1920. The clover and alfalfa seed chalcid-fly. USDA Bull. 481.